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**CLINICAL PRESENTATION OF MYCETOMA IN
CHILDREN, KNOWLEDGE, ATTITUDE AND PRACTICE
TOWARDS THE DISEASE AT MYCETOMA RESEARCH
CENTRE**

SOBA HOSPITAL

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صدق الله العظيم

سورة الرحمن
(الاية 1-4)

Dedication

To

*My father and mother
My brothers and sisters
My lovely son Ahmed
My friends
All paediatrician
Our lovely children*

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My great thanks and appreciation to my supervisor Dr. Yahia Shakir for his valuable advice, support and encouragement.

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Abstract

Mycetoma is a major health problem, in tropical and subtropical areas. It is dreadfully neglected by both society and health communities across the world. It affects the poor in Sudan and many other developing countries. A lot of studies had been done about mycetoma in adult, but none of them concentrated on infection among children. So there are insufficient studies done about mycetoma in children found in the literature and in the internet, both in Sudan and in the globe.

This is a prospective descriptive hospital based study. It was conducted at mycetoma Research Centre at Soba University Hospital. It aimed to study the clinical presentation of mycetoma in children and the knowledge, attitude and practice towards the disease.

The study period was six months. During this period 110 cases of mycetoma in children less than 18 years of age were reported. Each patient was interviewed using a questionnaire. The questionnaire contained personal data about the patients, clinical history and local and general examination of each patient and modalities of investigations used for diagnosis. The second point of the questionnaire contained questions about their knowledge, attitude and practice towards the disease.

The study revealed that mycetoma affect the poor in Sudan. The male predominate female by 3: 1. The majority of patient

(54.5%) between 15-18 years, 39.1% from 10-14 years and 6.4% from 5-9 years of age.

The disease prevails in the central part of Sudan (91%). Fungal mycetoma is the main type (95.5%). The lower limb is the commonest affected site (68%) and the left foot is more commonly affected than the right (44%). The majority seek medical advice after one year of infection (68.2%), and 62.7% of them present to the centre after recurrence. 65.4% presented with both sinuses and masses. 31.8% of the study group had bone infection. 39.1% had family history of mycetoma. 60.9% of them gave no history of previous trauma.

86.4% of patients had some knowledge about the disease and all of them took their knowledge from their treating doctors.

The cost of treatment is very expensive for (65.5%). So 32.7% of the study group used traditional treatment before seeking medical advice.

ملخص الاطروحة

تعد المايستوما من المشاكل الصحية الاساسية في كل المناطق الحارة وشبه الحارة وعلي الرغم من ذلك فهو مرض مهمل من قبل المجتمعات المحلية والصحية في كل العالم. وهو مرض يصيب الاقليات الفقيرة في السودان ومختلف الدول النامية - هنالك عدة دراسات اجريت حول هذا المرض وقد ركز اغلبها علي حدوث المرض في الكبار ولم تركز احدي هذه الدراسات علي حدوثه في الاطفال . ولهذا السبب لم توجد دراسات كافية في المراجع او في الانترنت عن حدوث المايستوما في الاطفال في السودان والعالم .

اجريت هذه الدراسة المستقبلية الوصفية في مركز ابحاث المايستوما بمستشفى سوبا الجامعي بغرض دراسة حدوث المايستوما في الاطفال اقل من 18 سنة ودراسة المعرفة والمواقف والممارسات تجاه هذا المرض .

اجريت هذه الدراسة في فترة 6 شهور وشملت 110 طفل مصابا بالمايستوما لعمر اقل من 18 سنة, حيث تم ملء استبيان لكل مريض ويحتوي هذا الاستبيان علي معلومات عن المريض واخذ التاريخ المرضي والاعراض السريرية للمرض وفحص المريض سريريا ومراجعة الفحوصات العامة والخاصة بالتشخيص والمتابعة وبعض الاسئلة عن معرفة المريض وأقاربه عن المرض ومواقفهم وممارستهم تجاهه.

اوضحت الدراسة ان المايستوما يصيب الفئات الفقيرة في السودان وان نسبة الاصابة اعلي عند الذكور عنهم في الاناث بنسبة 3:1 وان اعلي نسبة اصابة في الاطفال مابين 15-18 سنة بنسبة تبلغ 54.5% - بينما نسبة الاصابة في الاطفال مابين 10-14 سنة بلغت 39.1% وحوالي 6,4% في الاطفال اقل من 10 سنوات – كما اوضحت الدراسة ان وسط السودان اكثر المناطق اصابة بالمرض بنسبة 91%.

وان المايستوما الفطرية هي المسبب الرئيس نسبة 95.5% وان القدم هي اكثر الاماكن عرضة للاصابة بنسبة 68% وان القدم الايسر اكثر عرضه للاصابة بنسبة 44%.

وقد اوضحت الدراسة ايضا ان نسبة 68.2% طلبوا المشوره الصحية بعد الاصابة بالمرض بحوالي سنة كاملة ونسبة 62.7% حضروا الي مركزابحات المايستوما بعد تكرار الاصابة ونسبة 65.4% كانوا يعانون من ورم وافراز حبيبي – وان نسبة 31.8% يعانون من اصابة بالعظم ونسبة 39.1% لديهم اصابات مايستوما باسرههم . ونسبة 60.9% لم يذكروا سابقا اصابة بالقدم .

هنالك نسبة 86.4% من المرضى واسرههم لديهم بعض المعلومات عن المرض وكل هؤلاء المرضى استقوا هذه المعلومات من الاطباء المعالجين . هنالك نسبة 65.5% يعتقدون ان علاج المايستوما باهظ الثمن ومكلف جدا ومن بينهم نسبة 32.7% استخدموا عدة انواع من العلاجات البلدية .

List of abbreviations

<u>A. flavus:</u>	<u>Actinomycete flavus</u>
<u>A. israeli:</u>	<u>Actinomycete israeli</u>
<u>A. madurae:</u>	<u>Actinomycete madurae</u>
<u>A. pelletieri:</u>	<u>Actinomycete pelletieri</u>
CFT:	Complement Fixation
CIE:	Counterimmunoelectrophoresis
ELISA:	Enzyme Link ImmunoSorbant Assay
Ig:	Immunoglobulin
<u>M. mycetomatis:</u>	<u>Madurella mycetomatis</u>
<u>N. asteroides:</u>	<u>Nocardia asteroides</u>
<u>N. brasiliensis:</u>	<u>Nocardia brasiliensis</u>
PCR:	Polymerase Chain Reaction
PHC:	Primary Health Care
<u>S. somaliensis:</u>	<u>Streptomyces somaliensis</u>
SPSS:	Statistical Package for Social Sciences

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Chapter One

1- INTRODUCTION AND LITERATURE REVIEW

Mycetoma is a major health problem in tropical and subtropical areas and it is reported from different part of the globe, but it is dreadfully neglected by both society medical and health communities across the world⁽¹⁾.

There is very little or insufficient studies done about mycetoma in children both in Sudan and the globe found in the literatures and in the internet .

It is an important health problem affecting the poor in Sudan and many other developing countries. It is one of the neglected diseases and it is only recently that many of the previously unknown factors about the disease have been addressed seriously using newer techniques particularly in immunology, molecular biology, electron microscopy, ultrasonography and animal experimentation. This has resulted in better understanding of this challenging problem and consequently better management of patients⁽¹⁾.

Mycetoma is a chronic granulomatous, progressive inflammatory disease that involves the subcutaneous tissue after a traumatic inoculation of the causative organism. It may be caused by true fungi (eumycetes) or by higher bacteria (actinomycetes) and therefore it is classified into eumycetoma and actinomycetoma respectively⁽²⁾. The characteristic triad of a painless subcutaneous mass, sinuses and the discharge of grains are pathognomonic of mycetoma. The lesion usually presents as a slowly progressive painless swelling at the site of a previous trauma and gradually increases in size. It may spread to involve the skin and deep structure resulting in destruction of bone, deformity and loss of function with serious social and economic implications. The disease is progressive, the treatment may last for a long time, and some may develop recurrence after adequate treatment. The pathogens are found in the soil of the endemic areas as saprophytes and are introduced into the subcutaneous tissue by trauma ⁽³⁾.

1.1 Historical Background:

Mycetoma was probably known by the ancient Indian writers as padavalmita. The earliest medical description of mycetoma appears to be in the doctoral thesis of the German physician and traveler⁽⁴⁾.

Mycetoma was also named St. Thomas's bean as St. Thomas is said to have spent his last days in southern India⁽⁴⁾.

The first case of mycetoma infection has been reported from Medras town in India in 1812 and hence the name madura⁽⁵⁾.

Mycetoma was recorded by French missionaries in Ponchichery in India in 1812 where it was known there since 1710. Gill of the Madurrai Dispensary in Madras province, in southern India is frequently mistakenly quoted as the first to report on mycetoma in the medical literature. He described this condition as a foot covered with large fungoid excrescence discharging an offensive ichorous fluid⁽⁵⁾.

Godfrey in 1846 reported four patients with lumpy swellings of the foot in two of them there was bone destruction

and in the other two, cyst filled with melanotic matter were recorded. He named this condition “morbus tuberculosis pedis”⁽⁶⁾.

Celebrook (1848) introduced for the first time the term *madura foot*⁽⁷⁾.

Billingall in 1855 described the microscopic details of the disease, with respect to the bony changes and tissue destruction in mycetoma⁽⁸⁾.

Eyre (1859) reported 40 patients treated during 1844-1848. He drew attention to the small grains seen within the lesion and that the amputation was the treatment of choice⁽⁹⁾.

Minas (1860) reported mycetoma in hand and noted the prevalence of black grain mycetoma in his patients⁽¹⁰⁾.

Van Dyke center (1860) after isolation of the fungus, stressed the fungal parasitic origin of the disease and he was the first who coined the term mycetoma. He also described 2 varieties of mycetoma, the melanoid type with black granules and the orchoid one with white granules. He suggested that, the latter variety is produced by a different species of fungi⁽¹¹⁾.

Dymock (1881) reported for the first time on local recurrence after surgery in a patient with yellow mycetoma⁽¹²⁾.

Bocarro (1894) distinguish between the black and white mycetoma each of which had been caused by different organism⁽¹³⁾.

Boyce and Surveyor (1894) were able to describe the host tissue reaction to the organism ⁽¹⁴⁾.

Greymy and Vincent (1894) reported the first African case of mycetoma in Algeria and probably the patient contracted the infection when he was in Tunisia, and they isolated the anaerobic actinomycete ⁽¹⁵⁾.

Brumpt (1906) listed the causal agents of mycetoma ⁽¹⁶⁾.

Laveran (1906) described the micrococcus pelletierii ⁽¹⁷⁾.

Pinoy (1913) was the first to study actinomycotic agents and classified mycetoma organism into 2 main groups; the actinomycete and the true fungi ⁽¹⁸⁾.

1.2 Mycetoma in Sudan:

Sudan seems to be the mycetoma homeland. The disease had been known since the time of Mahdeya (1885-1899) or

before, it is commonly known by the name “Nebit” meaning growth⁽¹⁵⁾. However Belfur published the first documented case in 1904⁽¹⁹⁾. He noted that the disease was common amongst Northern Sudanese, that the foot was affected most and that the commonest type was the black grain variety ⁽¹⁹⁾. The first case from southern Sudan was reported from Bor in upper Nile by Weyon in 1908 ⁽²⁰⁾.

Chalmers and Archibald gave quite an elaborative and specific definition of mycetoma, and they introduced the term maduramycoses and actinomyces, proceeded afterwards to classify the mycetoma into maduromycetoma the grain of which are composed of large segmented mycelia and actinomycetoma with grains composed of fine non-segmented filaments ⁽²¹⁾.

In 1931 Grantham Hill made a detailed clinical study of 184 patient, out of which 64% were of the black variety and 36% were yellow, the yellow type being actinomycotic and the black is maduromycotic. He thought that the actinomycotic type was more virulent, infiltrates gradually and once it penetrate the periosteum it disseminates rapidly in bone while the black type forms a localized usually subcutaneous tumour. He thought

that the best routine treatment was surgical, and that the key to success lies in early recognition and complete removal. He was aware that amputation will defer patients from attending hospital and therefore encourage early detection. In his study he had 77% of patients treated by local removal and 23% by amputation. He supported the common belief that Nabit, usually follows a thorn prick by saying that in 30% of his patient with mycetoma of less than six month duration, thorns were actually found embedded in the growth after removal at operation ⁽¹⁸⁾.

Abbott in 1954 noted that trophic and neurological changes were absent in mycetoma patients. He also noted that the tendon and nerve lay unaffected in the middle of damage tissue ⁽²²⁾.

1.3 Epidemiology:

Mycetoma infection is worldwide distributed but more commonly in tropical and subtropical countries of Africa, the middle East, part of Asia and south America⁽²³⁾. These areas lies between 15°S – 30° N of the equator. These areas known as

mycetoma belt which includes Sudan, Senegal, India, Yemen, Mexico, Venezuela, Columbia Argentina and others. In Africa, mycetoma is most frequently seen in Sudan, Senegal, Mauritania, Kenya, Niger, Nigeria, Ethiopia, Chad, Cameroon Djibouti and Somalia ⁽²³⁾. However many cases have been reported in 10 temperate region ⁽²³⁾. The area where mycetoma is endemic share the factor that they have a short rainy season of 3-4 month, temperature of 30° – 37° C and hot, dry season of 8-9 month with temperature of 45° C and humidity of 12-18%⁽²³⁾. This weather favors the growth of Acacia and other thorny trees. The thorns are possibly parasitized by the causal organism, a prick by these thorn will introduce the organism directly into the body. The disease is common among rural people who come in direct contact with the soil such as farmers and those bare footed in endemic area⁽²⁴⁾.

The prevalence of one type or another depends on many factors. The climatic factor is an important one, type of soil and demographic feature of susceptible population⁽²⁵⁾. *M. mycetomatis* is common in tropical areas of Africa and India (rainy area), whereas *S. somaliensis* is predominant in middle

east, central and west Africa⁽²⁶⁾. It is sometimes seen in rainy areas in Mexico⁽²⁷⁾. In the relatively humid area *A. pelletieri* is common and in temperate region *Nocardia* species accounts for the main cause of actinomycetoma infection⁽²⁸⁾.

Few cases of eumycetoma have been reported in upper Egypt⁽²⁹⁾ and were all caused by *M. mycetomatis*.

A. madurae account for 70% of cases in Tunisia⁽²³⁾. Mycetoma is rare in Tunisia, and only observed sporadically, for this reason the diagnosis is usually late with severe functional, psychological and socioeconomic consequences⁽³⁰⁾.

130 cases of mycetoma were reported in Senegali patients between 1983 - 2000, 70% were due to actinomycetoma and 30% were due to eumycetoma⁽³¹⁾.

The disease is endemic in the northern areas of West Africa. It is more common in male, rural inhabitants and the age group was between 20 – 40 years of age. The main etiological agents are *S. somaliensis*, *A. pelletieri*, *A. madurae*, *M. mycetomatis* and *Leptosphaeria* species. In the west Sahelian belt actinomycetoma is more frequent than eumycetoma except in Mauritania. Ultrasonographic technique

appears to be very useful in medical centres where no mycological test can be done⁽³²⁾.

In Africa mycetoma is more frequent, in males and affects the age group between the second and fourth decades⁽³³⁾.

The Pasteur Institute studied 103 mycetoma patients in Somalia between 1959 and 1964. grains were seen in 94 of them and this, added to cultural features, allowed the diagnosis of 60 pathogens as follows: 44 Madurella mycetomatis, 1 Leptosphaeria senegalensis, 7 Pyrenochaeta remeroi (or Madurella grisea), 3 Allescheria boydii, 1 Fusarium species, 3 Neotestudina (Zopfia) rosatii, and 1 unidentified; 34 were actinomycetes: 24 Streptomyces somaliensis, 4 Actinomadura madurae, 3 A. pelletieri and 3 Nocardia species. The patients delayed too long in consulting their doctors and health education is vital if amputations are to be avoided. The geographical distribution is related to climate and fungal species. In central Somalia the association of M. mycetomatis and S. somaliensis, organisms characteristic of desert conditions, was found; white grain mycetomata and those caused by Nocardia species occurred in more humid areas. The study revealed 2 new fungi. One, obtained in culture was called

Neotestudina (Zopfia) rosatii. The 3 patients affected, lived in Mudugh (2 in El Bur). The other fungus was not identified. It also was recovered from El Bur and one with similar microscopic characters has been seen in Chad . Both fungi are desert species⁽³⁴⁾.

In Saudia Arabia the clinical and microbiological features of 31 cases of mycetoma seen in 8 years at a Riyadh hospital were described. Eighteen were due to Streptomyces somaliensis, 10 to Madurella mycetomatis and one each to Actinomadura madurae, Nocardia asteroides, and an unidentified species of Cladosporium. No immune defects were detected in the patients. Eleven had osteolytic lesions and 17 required surgery. Only seven patients were cured. Streptomyces infections were seen from all parts of Saudi Arabia outside the Rub Al Khali, but Madurella occurred mostly in highland regions where rainfall was higher⁽³⁵⁾.

Mycetoma is wide spread in Yemen but has not been fully documented. The majority of infections were due to eumycetes⁽³⁶⁾.

In west Bengal between 1981-2000, 264 cases of mycetoma were diagnosed clinically and microbiologically at Calcutta school of tropical medicine. The study revealed that the ratio of actinomycetoma and eumycetoma was 197 : 67, the male to female ratio was 183:81. Pricking was the most common injury associated with eumycetoma. The peak age of onset was between 16 and 25 years in 114 cases and the earliest age of onset was 6 years⁽³⁷⁾.

In India they reported a case of mycetoma of the sole of the foot in a 10 years old child caused by N. brasiliensis⁽³⁸⁾ and treated successfully with trimethoprim – sulphamethazole, dapsone and rifampicin.

In the United States, actinomycetoma caused by Actinomadura madurae occurred in an Indian factory worker⁽³⁹⁾. It is rare there and only one case of black grain infection has been reported in North America⁽⁴⁰⁾.

In south and central America N. brasiliensis is the commonest cause of mycetoma⁽³⁹⁾. It accounts for 85.6% of actinomycetoma cases in Mexico followed by A. madurae, S. somaliensis and A. pelletieri⁽²⁵⁾. A case of actinomycotic by N.

asteroids, a rare etiologic agent of infection has been reported in Brazil ⁽⁴¹⁾.

Biagini and his colleagues had reported 39 cases of mycetoma mainly caused by N. brasiliensis among Argentinian farmers⁽⁴²⁾

In central Europe, the disease is rare but cases have been reported from Italy and Romania. It is caused by both M. mycetomatis and A. madurae⁽²⁵⁾.

In Mexico mycetoma prevails in males and they are more frequent between 16-45 years of age among rural workers. Actinomycetomas are the most frequent⁽²⁷⁾. It preferentially affect the lower limb.

Few cases have been reported from each of the United State⁽⁴³⁾, Ceylon and Turkey^(44,45).

In Sudan, males are affected more than females in the ratio of 5 : 1⁽²²⁾. This is a genuine sex difference and is not related to the greater outdoors activities of males because in certain area in Sudan, males and females go out to work in the fields side by side. The disease is commoner between age group 20-40 years, this being the earning group, but no age group is

immune. In fact cases have been seen in children 4-5 years old⁽⁴⁶⁾.

1.4 Etiology:

True fungi (eumycetes) or aerobic bacteria (actinomycetes), which are higher class of filamentous bacteria, can cause mycetoma. Botryomycosis is a type of mycetoma infection caused by bacteria⁽⁴⁷⁾. In endemic area the causative agents have been isolated from soil as saprophytes^(48,49).

Eighteen species of eumycetes and actinomycetes have been isolated from cases all over the world⁽⁴⁶⁾.

Rarely, A. flavus can cause eumycetoma and a case of green grain eumycetoma due to A. flavus has been reported in Sudan⁽⁵⁰⁾ and another case caused by A. israeli.

In Sudan M. mycetomatis account for 71.4% of all mycetoma cases. S. somaliensis for 18% A. madurae 5.3%, A. pelletieri 2.7%⁽⁴⁶⁾.

Fungi that cause eumycetoma include M. mycetomatis, M. grisea, Leptosporia senegaliensis, Pyrenochaeta romeroi, Phialophore jenselmii, Curvularia lunata, peterilidium boydii, Aspergillus nidulans. A. flavus, Neotestudina rosatii and N. flavus. Actinomycetoma is mainly caused by S. somaliensis, A.

madurae, A. pelletieri and Nocardia species, which include N. brasiliensis, N. asteroides and N. otilidiscavarium⁽²⁶⁾.

Actinomycetoma is commoner than eumycetoma in Niger where the disease prevails. In the North desert zone, the disease is predominantly caused by S. somaliensis, whereas in the southern part it is caused by A. pelletieri, followed by N. brasiliensis and A. madurae⁽⁵¹⁾.

1.5 Route of infection:

Mycetoma is a non-contagious disease. The grains of the causative organism are usually found in the soil as saprophytes that when the rain moistens them they form conidia and other infectious forms. These forms can be introduced to the subcutaneous tissue by a trauma of skin by thorns, stones, or other sharp objects⁽²⁴⁾. Nevertheless, many patients gave no history of previous trauma⁽²⁾. The disease can occur naturally in a number of animal including goats⁽⁵²⁾, horses⁽⁵³⁾, donkeys⁽⁵⁴⁾, dogs⁽⁵⁵⁾ and cats⁽⁵⁶⁾. So far man to man or animal to man transmission is not known.

Incubation period:

The incubation period of mycetoma is unknown because of the difficulty in establishing the time of initial infection. However, in experimental animals the granuloma was noted after three weeks from the inoculation of the organism ⁽⁵⁷⁾.

1.6 Sites of infection:

Mycetoma is commonly seen in those parts, which are in contact with soil during walking sitting or lying down. The foot is the commonest site of mycetoma; it accounts for 70%. Usually the dorsal aspect is more affected than the forefoot and for unexplained reasons the left foot is more affected than the right foot ⁽²⁴⁾. The hand is the next commonest site (12%). However, other parts of the body are involved such as knee, arm, leg, head, neck, thigh, perineum and cervical ⁽⁵⁸⁾.

Unusual sites: include scapulo-thoracic including scapular, axillary and chest, kidney, abdominal wall, inguinal, buttock and the mastoid bone ⁽⁵⁹⁻⁶¹⁾.

Cranial mycetoma was proved to be fatal and difficult to treat⁽⁶²⁾.

1.7 Mycetoma radiology:

Mycetoma is known as a destructive osteolytic infectious disease and it produces many radiological changes. These changes are seen more in actinomycetoma infection and being less in eumycetoma infection ⁽⁶³⁾. Three different stages of the disease can be distinguished radiologically ⁽⁶³⁾.

Soft tissue granuloma: It appears as a dense shadow or scattered multiple granuloma.

Involvement of the cortex: many changes are seen with periosteal reaction.

Involvement of the whole bone: At this stage multiple cavities are seen in the bone.

The size and number of cavities are useful in distinguishing between eumycetoma and actinomycetoma. Eumycetoma produces large and few, with defined margin cavities, while cavities seen in actinomycetoma are smaller in size, numerous and have no definite margin ⁽⁶⁴⁾.

The difference in size of cavities is due to the difference in the grain's size and the difference in number is due to the aggressiveness of the causative organism ⁽²⁾. These cavities are filled with grains which gives bone support, hence fracture is not common in mycetoma ⁽²⁾. Periosteal bone erosion from

outside without cavitations is often seen with the involvement of the metatarsal bones and less frequently seen in the calcaneum ⁽⁶³⁾.

Osteomyelitis if present is readily detected. Osteoporosis distal to the affected part is common and this may be due to the disease atrophy or due to the compression of the bone and its blood supply by the granuloma ⁽²⁾.

Mycetoma has a characteristic ultrasonographic appearance; in eumycetoma the grains produce numerous, sharp hyper-reflective echoes and there are single or multiple thick walled cavities. In actinomycetoma, the findings are similar but the hyper-reflective echoes are fine, closely aggregated and commonly settle at the bottom of the cavities ⁽²⁾.

CT was used for the diagnosis of mycetoma, the sensitivity was found to be 62% and the specificity 94%, and the positive predictive values were 93%, while the negative values were 66% ⁽⁶⁵⁾.

1.8 Differential diagnosis:

It is worth mentioning that any swelling in endemic areas has to be considered as mycetoma until it is verified ⁽²⁾. The differential diagnosis of mycetoma includes many of soft

tissue tumors as Kaposi sarcoma, neurofibroma, malignant melanoma and fibrolipoma ⁽²³⁾.

The presence of bone destruction in the absence of sinuses tends to favour the possibility of tuberculosis ⁽⁶⁶⁾. The radiological features of advanced mycetoma may be comparable to those of osteogenic sarcoma ⁽²⁾. Also osseous mycetoma is to be differentiated from chronic osteomyelitis, osteoclastoma, and bone cysts and from syphilitic osteitis ⁽⁶⁶⁾.

1.9 Laboratory diagnosis:

Macro and microscopic examination: pus exudates, biopsy or tissue material can be examined for the presence of grains. The morphology, texture, colour and shape may indicate the causative organism. As the grains may not show typical colours especially among actinomycetes, other examinations are always necessary for definitive diagnosis⁽⁶⁷⁾.

Grains are crushed between two slides, few drops of 10% potassium hydroxide are added, covered with a coverglass and examined microscopically. Thus one can differentiate between actinomycetes and eumycetes as eumycetes have broad mycelia strands that may have large swollen cells (15 μ m or more),

while actinomycetes have fine filaments, which are 0.5 to 1 μm in diameter ⁽⁶⁸⁾.

Albert and Giemsa stains can also be used for staining and examining actinomycetes ⁽⁶⁸⁾.

Culture: For culture, grains are better obtained from deeper sites, as the grains extruded through sinuses are often dead and can be contaminated by secondary bacterial infection. Biopsy or tissue materials taken during surgery are ideal for culture ⁽⁵⁷⁾.

Actinomycotic grains are washed in normal saline, if large are crushed and then cultured on blood agar, brain heart infusion or Lowenstein – Jensen medium and incubated at 37°C for two to three weeks. Then, identification of type of actinomycetes depends on macroscopic morphology, characteristic colony morphology, physiological characteristics or reaction to certain chemical reagents ⁽⁶⁷⁾.

Eumycetoma grains are washed in normal saline containing an antibiotic such as chloramphenicol, to avoid bacterial contamination, and then cultured on blood agar or sabouraud dextrose agar and incubated at 37°C for six to eight

weeks, then identified by observation of rate of growth, colony morphology, production of conidia and assimilation patterns⁽⁶⁷⁾.

Grain morphology is so variable that it is not always an appropriate method to distinguish the type of organism. Nevertheless, some grains have definite morphology such as S. somaliensis, M. mycetomatis and A. pelletieri.

Culture of surgical biopsy from mycetoma lesion is essential for definitive diagnosis of mycetoma and presumptive identification of the possible causative agents by the appearance of characteristic grains. Nevertheless, culture is time consuming, prone to secondary bacterial contamination therefore needs deep surgical biopsy under general anaesthesia and not cost-effective in endemic areas⁽⁶⁷⁾.

Sero-diagnosis: serology has great advantages over culture and histopathology, as both required surgical biopsy, but it has the problem of lacking the standardized and well-characterized antigens and the cross reactivity between the different actinomycete antigen⁽²⁴⁾. Nevertheless, serology can be used in identification and classification of the causative organism, which is essential for the treatment and follow-up⁽²⁴⁾.

1.10 Pathology of mycetoma:

Like any chronic inflammation, mycetoma forms a granuloma. One or all the three types of reaction can be found in the same mycetoma lesion⁽⁶⁸⁾.

In type I reaction, there is a zone of neutrophils in the vicinity of the grain. Some histiocytes may also be seen among the neutrophils but they are numerous outside the neutrophil zone. Surrounding the neutrophil/histiocyte zone are abundant capillaries, which are sometimes surrounded by a layer of fibrin. Lymphocytes, plasma cells, fibroblasts and some macrophages are usually seen. They increase in number towards the periphery of the lesion ⁽⁶⁸⁾.

In type II reaction, most neutrophils mostly disappear and are replaced by histiocytes and multinucleated giant cells. Some giant cell in *M. mycetomatis* infection contain fragments of grain or pigmented cement substance without any hyphae. In actinomycetoma they contain viable actinomycetes which are believed to contribute to the spread of the organism in the tissue and the regional lymphnodes ⁽⁶²⁾. The grains at this stage are usually small and fragmented by neutrophils. This fragmentation is severe in *M. mycetomatis* infection and less in

actinomycete infection. This may be due to the more compact and hard grains of actinomycetes ⁽⁶⁸⁾.

In type III reaction, *M. mycetomatis* grains mostly or completely disappear leaving compact epithelioid granuloma with or without Langerhan's giant cells. This pure epithelioid granuloma is not seen in actinomycete infection ⁽⁶⁸⁾.

In spite of the invasive nature of actinomycetes, the grains neither invade tendons nor nerves. In the last stages of mycetoma infection, bone are frequently involved⁽²⁾.

Blood vessels in mycetoma show hypertrophy of muscles and have narrowed lumen containing grain fragments. These may explain the rare haematogenous spread to distant site ⁽²⁾.

Lymph-nodes are occasionally enlarged in mycetoma patients ⁽⁶⁹⁾. They show follicular and/or sinus cell hyperplasia, intense plasma cell infiltration in the medulla cords and some of the plasma cells contain Rossel bodies. Melanin pigment and haemosiderin are found in histiocytes. However, sometimes especially in actinomycete infection, grains are found in the nodes. In early cases only grains are found scattered in the node without any other change. Later, the node shows hyperplasia and deposits of melanin and haemosiderin.

Neutrophils polymorphs, histiocytes and giant cells were found. In advanced cases vascular fibrous tissues were seen and in more advanced cases no lymphoid tissue could be seen⁽⁶⁹⁾. These changes are of intense antigenic stimulation, partly due to the accompanying secondary bacterial infection and almost due to the fungal antigen stimulation.

1.11 Mycetoma immunology:

Antibodies against mycetoma organisms usually develop after infection. All three types of antibodies (IgA, IgG and IgM) are produced and they have been demonstrated by means of immunodiffusion, counterimmunoelectrophoresis (CIE), complement fixation (CF) and ELISA ^(70,71). CIE is regularly used for the diagnosis of mycetoma, identification of the individual organism and for following-up patients on medical treatment as they decrease with recovery and disappear with cure ⁽⁷²⁾.

Old study done in 1930 found that IgA increases irrespective of the causative agent and the extent of tissue involved in the lesion, while IgG and IgM show poor response in cases with extension of lesion to bone ⁽⁷³⁾.

PCR can also be used for identification of M. mycetomatis⁽⁷⁴⁾.

Microscopic appearance of *Madurella mycetomatis*:

M. mycetomatis is the main cause of mycetoma infection in Sudan. This organism has black, hard and big grains with size ranging between 200 to 900 μm . the grains may be rounded, oval, bilobated or trilobated in shape and they may aggregate to form a mass of 2 to 4 mm in size.

The main morphological types of grains are identified; the filamentous type, which is the commonest one; the other is the vesicular type. Both types of grains can be found in the same lesion. Moreover, grains, which are partially vesicular and partially filamentous, are commonly seen.

Ultrastructurally, the grains are found encased in dark brown cement, which is a unique feature of M. mycetomatis grains ⁽⁶¹⁾. As no individual cell component was visibly responsible of this dark colour, nor was any constant pigment particle identified, so the source of this pigment was thought to be the cell cytoplasm. Histologically it resembles melanin or it may be a fungus product ⁽²⁸⁾. The hyphae are septate, the

cytoplasm may be densely ribosomal or disorganized. Nuclei and mitochondria and other organelles are not usually seen. Intra-hyphal growth is sometimes seen. The hyphal wall is often markedly thickened, surrounded by homogenous matrix of electron dense area and a layer of cement outside it ⁽²⁸⁾.

Study of the ultrastructural host tissue reaction shows neutrophils adherent to the grain. The cytoplasm of the neutrophils is stretched over the grain and the neutrophil granules are concentrated in the part of the cytoplasm adjacent to the grain. This is an immune adherence mediated by immunoglobulins and is an example of antibody dependent cell mediated cytotoxicity ⁽²⁸⁾.

1.12 Treatment of mycetoma:

Treatment of *M. mycetomatis* infection is difficult. Rate of recurrence after surgery is high. Therefore, combination of medical treatment with surgery is important. Although, the grains were sensitive to ketoconazole in the in vitro test ⁽⁶²⁾. In vivo the recurrent rate is high. It is thought that many ultrastructure features account for the difficulty of treating the *M. mycetomatis* infection with antifungal drugs. The

homogenous matrix of electron dense, the layer of the cement that surround the grains and the maximum thickening of the cell wall at the periphery of the grains, are thought to prevent penetration of drugs and so increase the recurrence rate ^(75,28).

In the past, the treatment of mycetoma in Sudan was practiced by the native practitioner by cautery and/or amputation ⁽¹⁸⁾. In a small survey done in Sudan it was found that many types of native medicines were used.

In 1931, the senior surgeon at Khartoum Hospital doubted the value of medical treatment by various drugs suggested up to that date. He thought that the best treatment was surgical excision especially if it was in the early stages when complete removal could be done. However, he was faced by a high rate of recurrence due to the difficulty of adequate removal ⁽²²⁾. Later on, in 1955 in vitro trials with different antibiotics such as chloramphenicol, oxytetracycline, carbamycin and polymyxin-B against *M. mycetomatis* were carried out. The organism was found to be resistant to all of them ⁽⁷⁶⁾.

Treatment of actinomycetes has been tried successfully with a combination of streptomycin in a dose of 14 mg/kg daily for the first month and then on alternate days combined with 1.5 mg/kg morning and evening of dapsone. 14 mg/kg twice a day of cotrimoxazole, 7.5 mg/kg twice weekly of sulphadoxine-pyrimethamine or 4.3 mg/kg body weight of rifampicin twice daily ⁽⁶⁸⁾. This regimen is now accepted globally and becomes the standard regimen for treatment of actinomycetoma. Recently, for patients resistant to these drugs, amikacin was used alone with 95% cure rate or in combination with cefotaxime, 1 g every 8 hours and amikacin, 500mg every 12 hours in two cycles. Surgery in actinomycetoma infection is not preferred as it is thought to facilitate the grains spread through lymphatics system to other parts and also because its lesion usually has an ill-defined margin ⁽²⁾.

Eumycetoma treatment has the drawback problem of recurrence. Therefore, medical treatment after surgery is suggested to minimize the recurrence. Ketoconazole in two divided doses has been tried for the treatment of *M. mycetomatis* infection ⁽⁷⁷⁾. A combination of griseofulvin three

times a day and procaine penicillin given intramuscularly was used as another regimen for the treatment of eumycetoma but with little success. Nevertheless, the problem of recurrence or incomplete cure especially in the case of massive lesions is still an obstacle. Hence, a different treatment strategy has been adopted. This is by giving the patient a drug for a short time, a debulking or complete removal of the lesion with bone curettage is recommended, surgery should be performed under a bloodless field, using tourniquet, and under general anaesthesia and then this is followed by another period of drug treatment for six to twelve months . This course of treatment has been found to be the best to minimize the recurrence rate, but even though it is still high ⁽²⁾.

Recently the newer antifungal, itraconazole has been used to treat different types of eumycetoma including *M. mycetomatis* infection ⁽⁷⁸⁾.

In Senegal they reported 90 cases of actinomycetoma occurring in male adult patients coming mainly from central Senegal. The lesion localized on the foot in 50% of cases and other part of the body for the other half. Bone involvement was

observed in 55% of cases. 83% of patients were cured after one year treatment of sulphamethoxazole orally. 2 patients died of visceral involvement ⁽⁷⁹⁾.

Mycetoma is uncommon in children. Retrospective study was conducted in children less than 15 years of age during 25 years period. Total number of patient was 334; 15 of which (4.5%) were in patients 15 years of age and younger. Age range between 6-15 years and the mean age was (11.24); 12 were male and 3 females. The main site was the foot in 10 patients (66.6%). Aetiologies include 13 actinomycetoma, 2 eumycetoma. Etiologic agents were Nocardia brasiliensis in 12 cases. Nocardia asteroides⁽¹⁾ and Madurella mycetomatis in 2. 11 of 13 active treatment with trimethoprim – sulphamethoxazole plus diaminodiphenyl sulphone were cured. The 2 failure were successfully treated with amoxicillin/clavulenate. One of eumycetoma was cured with itraconazole therapy, whereas other various treatment eventuating in surgical amputation⁽⁸⁰⁾.

Treatment with cotrimoxazole in two immunocompetent children, exhibit two clinical form of cutaneous nocardiosis (mycetoma) led to complete healing ⁽⁸¹⁾.

Study was done in Mexico to determine the incidence and epidemiology of mycetoma. The data was collected from 2105 cases through about 30 years (1956-1985). Sex distribution was 76.1% in males and 23% in females. 35% of cases between 16-30 years of age. Lower limb was affected in 64.1%, upper limb in 13.6% and the trunk in 17.4%. The causative agent was actinomycetes in 97.8% and eumycetes in 2.2%⁽⁸²⁾

Justifications

- Mycetoma is a common disease in Sudan
- It has high morbidity.
- It affects all age groups
- Its complications are preventable disease.
- No study had been done specifically in children.
- No educational program had been carried out about mycetoma in Sudan.

Objectives

To study:

- The clinical presentation of mycetoma in children.
- The knowledge, attitudes and practice towards the disease.

2- Methodology

2.1 Study Design:

Prospective -Descriptive – Hospital based study.

2.2 Study Area:

Mycetoma research centre at Soba University Hospital –
Khartoum - Sudan.

2.3 Study Period:

From May 2006 to September 2006.

2.4 Study Population:

2.4.1. Study sample:

All children attending mycetoma referral clinic who are
18 years and less during the study period.

2.4.2. Sample size:

Total coverage sample for all children who attended
mycetoma during the study period

2.5 Inclusion criteria:

Children < 18 years with mycetoma.

2.6 Exclusion criteria:

- Undiagnosed patient.
- Refusal of patient or their parent to be enrolled in the study.

2.7.Methods:

2.7.1.Study tools :

- Questionnaire.
- History clinical examination and preformed investigations.
- Biopsy and FNA results

2.7.2. Study technique:

- Questionnaire for data collection containing personal data clinical history, general and local examinations.

- The child and his/her caretaker was interviewed through the questionnaire by the author.
- A through clinical examinations were conducted for each child.
- Relevant investigations done to those children were recorded including CBC, liver function tests , X-rays and results of FNA and histopathology.
- FNA and histopathology were done by consultant histopathologist and the findings were recorded.

2.8. Ethical approval:

- Written approval will be obtained from hospital administrations.
- Written approval will be obtained from the director of mycetoma research centre.

- Verbal consent will be taken from the patients and their parents.



2.9 Statistics:

The data was entered and analyzed using the SPSS (Statistical Package for Social Sciences) computer program. Cross tabulation between variable was done. The X2 test was used with p value at 95% confidence level was used as the test of significant, probability value of < 0.05 was considered significant.

2.10. Research team:

- Researcher.
- Histopathologist.
- Statistician.

Chapter Three

3- Results

The study groups were all children 18 years of age and less, who attended the mycetoma referred clinic at Soba University Hospital ;and had been diagnosed as cases of mycetoma. The study groups were 110 patients during the study period, all of them came from rural areas from different parts of the Sudan, and all of them were of low socio-economic class. The gender distribution were 74% in males and 26% were females. (*Figure 1*)

Distribution of patients according to age was 54.5% between 15-18 years, 39.1% between 10-14 years and 6.4% from 5-9 years of age. The youngest age of presentation in the study group was 5 years of age. (*Figure 2*)

Distribution of patients according to residence was 91% from central part of Sudan mainly from Gezeira and Sinnar State, respectively, 7.2% from the west, 0.9% from the east, 0.9% from the south and there was no patient from the North. (*Figure 3*)

The most commonly affected site was the lower limb (68%) and the left foot is more commonly affected than the right (44%). The other affected site was the upper limb (5.8%), while the other part of the body e.g. scrotum, knee and leg constitute for 8.2% of the study group. *(Figure 4)*

The majority of the study group presented after one year of infection (68.2%), 15.4% less than one year and 16.4% present after 5 years of infection. *(Figure 5)*

The majority presented to the centre after recurrence (62.7%) while these who had first presentation constitute for 37.3%. *(Figure 6)*

65.4% of patient presented with both sinuses and mass, 17.3% presented with mass only and 17.3% with sinuses mainly. *(Figure 7)*

The causative organism was mainly fungi (95.5%) and bacterial type in 4.5% of the study group. *(Figure 8)*

The bone was affected in 31.8%, (*Figure 9*) and there is no relation between the age of the patient and bone involvement. The difference was statistically not significant ($P > 0.1$). (*Table 1*)

The bone was involved mostly in patients presented between 1-5 years duration (57.1%), 8.6% in those who presented less than 1 years of infection and 34.3% in those who present after 5 years of affection. The difference was statistically significant ($P < 0.01$). (*Table 2*)

There was family history in 39.1% of the study group . (*Figure 10*)

Table 1: Relation between age of the study group and bone involvement

Age (Year)	Bone infection		None		Total	
	n	%	n	%	n	%
5-9	3	8.6	4	5.3	7	6.5
10-14	17	48.6	26	34.7	43	39.1
> 15	15	42.8	45	60	60	54.5
Total	35	100.0	75	100.0	110	100.0

$$X^2 = 2.85919$$

$$P > 0.1$$

Table 2: Relation between duration of illness and bone involvement

Age (Year)	Bone infection		None		Total	
	n	%	n	%	n	%
< 1	3	8.6	14	18.7	17	15.4
1-5	20	57.1	55	73.3	75	68.2
> 5	12	34.3	6	8	18	16.4
Total	35	100.0	75	100.0	110	100.0

$$X^2 = 12.56732$$

$$P < 0.01$$

The majority of the study group 60.9% gave no history of previous trauma. (*Figure 11*)

85.7% of patient with bone involvement ha eumycetoma. The relation between the causative organism and bone involvement was statistically significant ($P < 0.01$) (*Table 3*)

The majority of fungal infection occurs in the central part of Sudan (94.3%). The difference was statistically significant ($P < 0.01$). (*Table 4*)

85.7% of patient with bone involvement had recurrent of mycetoma . The difference was statistically significant ($P < 0.001$). (*Table 5*)

Most of the study group had some knowledge about the disease (86.4%) (*Figure 12*) . All of them took their knowledge from their treating doctors .In this study there is no relation between their knowledge and chronicity of the disease. The difference was statistically significant ($P < 0.1$). (*Table 6*)

Table 3: Relation between causative agent and bone involvement

Agent	Bone		None		Total	
	Involvement					
	n	%	n	%	n	%
Fungi	30	85.7	75	100	105	95.5
Bacteria	5	14.3	0	0	5	4.5
Total	35	100.0	75	100.0	110	100.0

$$X^2 = 11.22449$$

$$P < 0.001$$

**Table 4: Relation between causative agent and Residence
of the study group**

Residence	Fungi		Bacteria		Total	
	n	%	n	%	n	%
North	0	0	0	0	0	0
South	0	0	1	20	1	0.9
West	4	3.9	3	60	7	6.4
East	1	0.9	0	0	1	0.9
Central	100	95.2	1	20	101	91.8
Total	105	100.0	5	100.0	110	100.0

$$X^2 = 47.670376$$

$$P < 0.01$$

Table 5: Relation between chronicity of the disease and bone involvement

Presentation	Bone		None		Total	
	Involvement					
	n	%	n	%	n	%
First	5	14.3	36	48	41	37.3
Recurrent	30	85.7	39	52	69	62.7
Total	35	100.0	75	100.0	110	100.0

$$X^2 = 11.601576$$

$$P < 0.001$$

Table 6: Relation between the knowledge of patients and chronicity of the disease

Knowledge	First		Recurrent		Total	
	presentation		presentation			
	n	%	n	%	n	%
Yes	33	80.5	62	89.9	95	86.4
No	8	19.5	7	10.1	15	13.6
Total	41	100	69	100.0	110	100.0

$$X^2 = 1.9161814$$

$$P > 0.1$$

65.5% of patients thought that the treatment of mycetoma is very expensive, (*Figure 13*) and in spite of this 63.3% were adherent to treatment (*Figure 14*), and 76.9% of them had no bone involvement. The difference was statistically significant ($P < 0.01$). (*Table 7*)

32.7% of the study group used traditional treatment before seeking medical advice (*Figure 15*).

Treatment was in form of Mehaya in 5.5%, labkha (24.5% and cautary in 0.9%. (*Figure 16*). In this study there was no relation between uses of traditional treatment and bone involvement ($P > 0.5$). (*Table 8*)

Table 7: Relation between adherence to treatment and bone involvement

Treatment	Bone Involvement		None		Total	
	n	%	n	%	n	%
Adherent	15	42.8	50	66.7	65	59.1
Not adherent	20	57.2	25	33.3	45	40.9
Total	35	100.0	75	100.0	110	100.0

$$X^2 = 5.59625$$

$$P < 0.01$$

Table 8: Relation between uses of traditional and bone involvement

Uses of traditional treatment	Bone Involvement		None		Total	
	n	%	n	%	n	%
Yes	11	31.4	25	33.3	36	32.7
No	24	68.6	50	66.7	74	67.3
Total	35	100.0	75	100.0	110	100.0

$$X^2 = 0.039325$$

$$P > 0.5$$

Chapter Four

4- DISCUSSION

This is a prospective, descriptive, hospital based study, conducted at Mycetoma Research Centre at Soba University Hospital . It aimed to study the clinical presentation of mycetoma in children less than eighteen years of age and their knowledge, attitude and practice towards the disease. This study showed that mycetoma can occur in children similar to that reported by Gumaa S A⁽⁴⁶⁾ who concluded that it does occur in children. Also agree with Develoux⁽³²⁾ who reported Mycetoma in children .

The majority of cases were above ten year of age (60.9 %). The male to female ratio is 3 : 1 which was in agree with study done in Mexico (M : F = 4 : 1)⁽⁸⁰⁾.

All patients were from rural areas from different parts of Sudan, but the central part had the highest percentage of patients which was in agreement with study done before in adults⁽⁴⁶⁾.

The lower limb was affected in 87.5% of the study group while the other part of the body constitutes for (12.5 %) which

was the same with study done in Sudan in which the foot was affected in (70%) of the study group⁽²⁴⁾ and Mexico where the foot was affected in 66.6% of the study group⁽⁸⁰⁾.

84.6% of patient presented after one year of infection, so there is delayed presentation to doctors as compared to study done in Somalia where they found that the patients had delayed presentation⁽³⁴⁾.

From those 62.7% presented with recurrent symptoms after treatment in other hospitals. 39.1% of the study group gave no history of previous trauma, in contrast to study done in west Bangal where they noticed that the pricking was the most common injury associated with eumycetes⁽³⁷⁾.

39.1% of the study group gave history of mycetoma in their families who were mainly rural inhabitants, this goes with study done in West Africa ⁽³⁴⁾ and in Saudi Arabia ⁽³⁵⁾.

The majority of patients (65.5%) presented with both sinuses and masses.

The majority of patients (73.6%) were diagnosed by histopathology after surgery.

In 95.5% of the study group fungal mycetoma was the commonest type, in contrast to study done in West Bangal

where actinomycetoma predominated over eumycetoma (183 : 81) ⁽³⁷⁾, and this also occurred in Saudi Arabia ⁽³⁵⁾, but it agrees with study done in Somalia ⁽³⁴⁾ and Yemen ⁽³⁶⁾ where fungal mycetoma predominate.

31.8% of the study group had bone involvement and 2 patients of them ended in amputation. 86.4% of the study group had some knowledge about the disease and all of them took these informations from their treating doctors.

There were 32.7% of the study group who had some trial with traditional treatment, from which we noticed that there is no relation between uses of traditional treatment and affection of bone in the study group ($P > 0.5$), but there is strong correlation between the causative agent and affection of bone. Almost all cases due to bacterial type had bone involvement. While 85.7% of bone infection are caused by fungal mycetoma ($P < 0.001$).

59.1% of the study group were adherent to treatment and used it regularly without interruption, but 42.9% of those with bone infection were among those adherent to treatment, so

there is strong relation between adherence to treatment and bone infection in the study group ($P < 0.01$).

Conclusion

- Mycetoma commonly occurs in children especially these from rural area in Sudan.
- It is less common in children less than 10 years of age and more common above 10 years of age.
- Males predominate.
- It affects the foot more frequently than the other parts of the body.
- The majority had late presentation.
- Fungal mycetoma predominate the bacterial type (21:1).
- The majority of patient were diagnosed after surgery by histopathology.
- There was no obvious history of trauma in the majority of the study group.
- The majority of patients were not aware about the disease; and those who had some knowledge, acquired it from the doctors and medical staff. So the multimedia had no role in the awareness of the population about the disease.

- The treatment of mycetoma is very expensive and there is no support from the Ministry of Health or hospitals nor the health insurance. So some of the patients are not adherent to treatment and they end up by very serious complications.
- There is no relation between the age of the patient and the affection of bone, but there is strong association between the long duration of the disease (more than one year) and the bone involvement which is very serious complication that will end up by amputation.
- There is no association between the use of traditional treatment and bone involvement in the study group.
- All cases of bacterial type have bone involvement irrespective of the duration.
- Most of fungal mycetoma prevails in the central part of the Sudan, while the bacterial type prevails in the south and west.

Recommendations

1. To reduce the rate of mycetoma infection we need to raise the awareness of the people and medical staff about the importance of early detection .
2. Mycetoma control programmes are to be incorporated in the PHC programmes.
3. Availability of free treatment because the patients affected are from poor families .
4. Establishment of mycetoma centre in central region where most of the patient are coming .

Chapter Four

5- DISCUSSION

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Conclusion

- Mycetoma commonly occurs in children especially these from rural area in Sudan.
- It is less common in children less than 10 years of age and more common above 10 years of age.
- Males predominate.
- It affects the foot more frequently than the other parts of the body.
- The majority had late presentation.
- Fungal mycetoma predominate the bacterial type (21:1).
- The majority of patient were diagnosed after surgery by histopathology.
- There was no obvious history of trauma in the majority of the study group.
- The majority of patients were not aware about the disease; and those who had some knowledge, acquired it from the doctors and medical staff. So the multimedia had no role in the awareness of the population about the disease.

- The treatment of mycetoma is very expensive and there is no support from the Ministry of Health or hospitals nor the health insurance. So some of the patients are not adherent to treatment and they end up with very serious complications.
- There is no relation between the age of the patient and the affection of bone, but there is strong association between the long duration of the disease (more than one year) and the bone involvement which is very serious complication that will end up with amputation.
- There is no association between the use of traditional treatment and bone involvement in the study group.
- All cases of bacterial type have bone involvement irrespective of the duration.
- Most of fungal mycetoma prevails in the central part of the Sudan, while the bacterial type prevails in the south and west.

Recommendations

1. To reduce the rate of mycetoma infection we need to raise the awareness of the people and medical staff about the importance of early detection .
2. Mycetoma control programmes are to be incorporated in the PHC programmes.
3. Availability of free treatment because the patients affected are from poor families .
4. Establishment of mycetoma centre in central region where most of the patient are coming .